

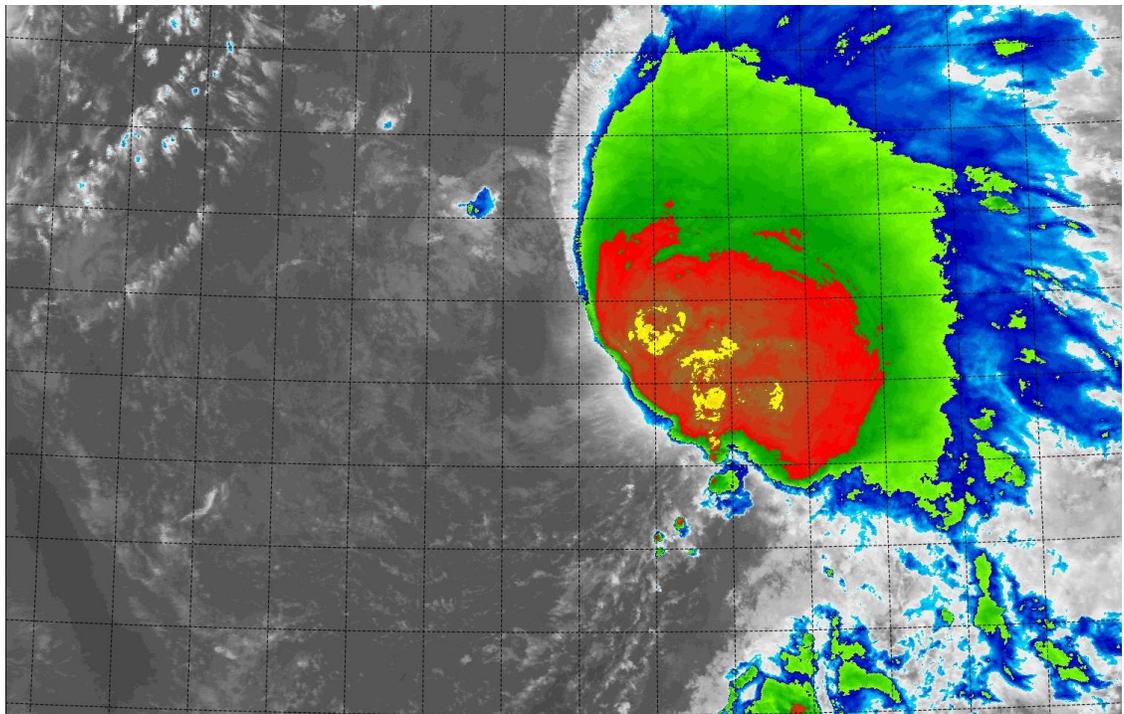


# CENTRAL PACIFIC HURRICANE CENTER TROPICAL CYCLONE REPORT

## TROPICAL STORM MALIA (CP052015)

18 – 23 September 2015

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AQUA MODIS INFRARED SATELLITE IMAGE OF TROPICAL STORM MALIA AT 0045Z 21 SEPTEMBER 2015.

Tropical Storm Malia formed in the southwestern portion of the central north Pacific basin and tracked northward near the International Date Line, through the northwest Hawaiian Islands, before being absorbed into an extra-tropical cyclone on 23 September 2015.

# Tropical Storm Malia

18 – 23 SEPTEMBER 2015

## SYNOPTIC HISTORY

The origin of Malia can be traced back to a trough of low pressure which traveled across the Central Pacific beginning on 9 September around 5N 140W, or around 1250 nautical miles (nm) to the southeast of Hilo, Hawaii. Showers and thunderstorms fluctuated in coverage and intensity as the trough made its journey across the Central Pacific, tracking generally off to the west at around 5 degrees of longitude per day. The area of convection became better organized by 0600 UTC on 17 September, with a broad circulation becoming evident in satellite imagery. The shower and thunderstorm activity associated with the broad low pressure area, became more persistent over the next couple of days in an environment characterized by very warm sea surface temperatures (SSTs) and low vertical wind shear. A large burst of convection around 1800 UTC on 18 September, led to the development of a tropical depression around 1050 nm west-southwest of Honolulu, HI. The “best track” chart of the tropical cyclone’s path is given in Fig. 1. The best track positions and intensities are listed in Table 1<sup>1</sup>.

The newly formed tropical depression tracked northeastward over the next couple days between a deep layer ridge well northeast of the cyclone and a digging mid-upper level trough approaching from the northwest. Deep convection continued to flare to the northeast of the low-level circulation center (LLCC), but organization and intensification was limited due to strong southwesterly vertical wind shear. By 0000 UTC 21 September, persistent deep convection was finally able to become established over the LLCC, which led to the formation of tropical storm Malia, quite remarkably, the 5<sup>th</sup> tropical cyclone of the year to develop in the central Pacific basin. Malia tracked generally off to the north over the next 24 hours, reaching its maximum intensity of 45 kt at 1200 UTC 21 September, around 40 nm southeast of the Island of Laysan in the northwest Hawaiian Islands. The closest point of approach Malia made to the Island of Laysan was around 1500 UTC 21 September, when it passed by roughly 20 nm to the east.

Tropical storm Malia then tracked toward the northwest over the next couple of days as the system became increasingly influenced by a deep upper level trough just east of the International Date Line. The trough created an increasingly hostile environment, with strong westerly vertical wind shear further displacing deep convection away from the LLCC, leading to slow weakening of the cyclone. Malia lost all deep convection by 1800 UTC 22 September, making it a post-tropical remnant low. The low continued to track northward through 0000 UTC 23 September, before becoming absorbed by an extra-tropical low over the north-central Pacific.

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<sup>1</sup> A digital record of the complete best track, including wind radii, can be found on line at <ftp://ftp.nhc.noaa.gov/atcf>. Data for the current year’s storms are located in the *btk* directory, while previous years’ data are located in the *archive* directory.

## METEOROLOGICAL STATISTICS

Observations in Malia include subjective satellite-based Dvorak technique intensity estimates from the Central Pacific Hurricane Center (CPHC), the Satellite Analysis Branch (SAB), the Joint Typhoon Warning Center (JTWC), and objective Advanced Dvorak Technique (ADT) estimates from the Cooperative Institute for Meteorological Satellite Studies/University of Wisconsin-Madison. Data and imagery from NOAA polar-orbiting satellites including the Advanced Microwave Sounding Unit (AMSU), the NASA Global Precipitation Mission (GPM), the European Space Agency's Advanced Scatterometer (ASCAT), and Defense Meteorological Satellite Program (DMSP) satellites, among others, were also useful in constructing the best track of Tropical Storm Malia.

The estimated 45-kt peak intensity of Malia is based on a 0912z ASCAT pass on 21 September 2015, showing a large swath of 40 knot winds with embedded 45 knot winds. The minimum central pressure of 992 mb at 1200 UTC 21 September is based on the Knaff-Zehr-Courtney (KZC) pressure-wind relationship for an intensity of 45 kt.

There were no ship reports of surface observations of winds of tropical storm force associated with Malia.

## CASUALTY AND DAMAGE STATISTICS

There were no reports of damage or casualties associated with Malia

## FORECAST AND WARNING CRITIQUE

Malia's genesis was generally well forecast (Table 2). The system that became Malia was introduced into the Tropical Weather Outlook (TWO) with a low (< 40%) probability of formation during the next 48 h, 66 h before formation. The TWO included a medium (40-60%) probability of formation 30 h before genesis. The forecast then deteriorated as the probabilities were dropped back into the low (<40%) category with the 1200 UTC 18 September TWO as a result of a loss of deep convection with the system. Deep convection quickly became established near the LLCC thereafter, and a tropical depression formed at 1800 UTC 18 September.

A verification of CPHC official track forecasts for Malia is given in Table 3a. Official forecast track errors were greater than the mean official errors for the previous 5-yr period at all forecast hours. A homogeneous comparison of the official track errors with selected guidance models is given in Table 3b. Malia was a very shallow system where the LLCC was very difficult to determine at times. This contributed to a large spread in model track guidance, with large errors in track noted amongst all statistical and dynamical models, as well as the official forecast.

The top performing models were, the consensus track guidance TVCN, and somewhat surprisingly the dynamical HWFI model, both of which bested the official forecast at each forecast period.

A verification of CPHC official intensity forecasts for Malia is given in Table 4a. Official forecast intensity errors were lower than the mean official errors for the previous 5-yr period at all forecast hours. A homogeneous comparison of the official intensity errors with selected guidance models is given in Table 4b. Overall, the official intensity forecast was very good, but so were the intensity forecasts of the statistical and dynamical models. The IVCN and HWFI were able to beat the official forecast at times during Malia. Surprisingly, the EMXI was one of the top performing intensity models, besting the official forecast at all but the 12 h forecast.

Tropical Watches were issued for the central portions of the Papahānaumokuākea National Marine Monument from Lisianski Island to Maro Reef to French Frigate Shoals with the initial advisory for tropical depression 5C, at 0300 UTC 19 September. This watch was upgraded to a warning at 1500 UTC 19 September, with the forecast track bringing Tropical Storm conditions to this section of the northwest Hawaiian Islands. Due to the uncertainty in the track guidance at that time, a tropical storm watch was also issued for the western portion of the Papahānaumokuākea National Marine Monument from Lisianski Island to Pearl to Hermes.

The track of the tropical cyclone became increasingly clear by the 0300 UTC 21 September advisory, that the area from Lisianski Island to Pearl to Hermes would not be impacted by tropical storm conditions. As a result, the tropical storm watch was cancelled, but the tropical storm warning from Lisianski to Maro Reef to French Frigate Shoals remained in effect. Based on the track of Malia, around 20 nm to the east of the island of Laysan (located between Lisianski and Maro Reef) at 1500 UTC 21 September as a 40 kt tropical storm, it appears the warning and watch decisions worked out very well. Malia moved far enough away from the northwestern Hawaiian Islands, that the tropical storm warning was cancelled with the 1500 UTC forecast advisory on 22 September.



Table 1. Best track for Malia 18-23 September 2015.

Date/Time (UTC)	Latitude (°N)	Longitude (°W)	Pressure (mb)	Wind Speed (kt)	Stage
18/1800	17.2	176.0	1005	30	Tropical Depression
19/0000	17.7	175.4	1005	30	"
19/0600	18.0	175.0	1005	30	"
19/1200	18.3	174.7	1005	30	"
19/1800	18.7	174.4	1005	30	"
20/0000	19.2	174.1	1005	30	"
20/0600	19.7	173.8	1005	30	"
20/1200	20.5	173.5	1005	30	"
20/1800	21.8	173.2	1005	30	"
21/0000	23.1	172.5	1001	35	Tropical Storm
21/0600	24.1	171.8	998	40	"
21/1200	25.2	171.4	992	45	"
21/1800	26.4	171.3	993	40	"
22/0000	27.1	172.0	993	40	"
22/0600	27.5	172.4	994	35	"
22/1200	28.2	173.0	994	35	"
22/1800	29.3	173.3	996	35	Low
23/0000	30.8	173.5	996	35	"
21/1200	25.2	171.4	992	45	Minimum Pressure and Maximum Wind

Table 2. Number of hours in advance of formation associated with the first CPHC Tropical Weather Outlook forecast in the indicated likelihood category. Note that the timings for the “Low” category do not include forecasts of a 0% chance of genesis.

	Hours Before Genesis	
	48-Hour Outlook	120-Hour Outlook
Low (<40%)	66	N/A
Medium (40%-60%)	30	N/A
High (>60%)	0	N/A

Table 3a. CPHC official (OFCL) and climatology-persistence skill baseline (OCD5) track forecast errors (n mi) for Malia. Mean errors for the previous 5-yr period are shown for comparison. Official errors that are smaller than the 5-yr means are shown in boldface type.

	Forecast Period (h)						
	12	24	36	48	72	96	120
OFCL	61.3	68.1	82.2	96.9	178.0	-	-
OCD5	81.0	150.8	185.9	218.7	208.3	-	-
Forecasts	13	11	9	7	2	0	0
(CP) OFCL (2010-14)	27.9	44.1	56.7	73.9	132.3	183.7	258.9

Table 3b. Homogeneous comparison of selected track forecast guidance models (in n mi) for Malia. Errors smaller than the CPHC official forecast are shown in boldface type. The number of official forecasts shown here will generally be smaller than that shown in Table 3a due to the homogeneity requirement.

Model ID	Forecast Period (h)						
	12	24	36	48	72	96	120
OFCL	56.5	66.1	65.6	96.0	178.0	-	-
OCD5	82.5	151.9	205.2	237.0	208.3	-	-
BAMD	81.4	98.8	115.9	186.4	412.4	-	-
BAMM	58.2	79.3	70.6	<b>69.2</b>	<b>161.3</b>	-	-
BAMS	<b>54.4</b>	73.6	71.6	<b>62.7</b>	<b>76.7</b>	-	-
HWFI	<b>48.7</b>	<b>51.6</b>	<b>44.9</b>	<b>66.4</b>	<b>127.4</b>	-	-
GHMI	61.9	96.8	150.7	237.3	455.7	-	-
AVNI	<b>56.2</b>	85.4	113.5	159.8	248.3	-	-
AEMI	57.2	66.9	68.3	<b>81.0</b>	<b>111.5</b>	-	-
EGRI	<b>37.7</b>	<b>54.7</b>	108.5	159.8	262.2	-	-
NGXI	62.8	84.6	85.9	123.0	354.0	-	-
CMCI	<b>54.5</b>	87.8	124.9	212.3	450.8	-	-
EMXI	<b>50.0</b>	68.1	<b>60.2</b>	<b>49.2</b>	<b>60.7</b>	-	-
TVCN	<b>45.9</b>	<b>50.8</b>	<b>49.8</b>	<b>69.8</b>	<b>119.9</b>	-	-
GFEX	<b>47.7</b>	<b>61.7</b>	66.3	<b>85.2</b>	<b>135.2</b>	-	-
Forecasts	7	6	6	6	2	0	0

Table 4a. CPHC official (OFCL) and climatology-persistence skill baseline (OCD5) intensity forecast errors (kt) for Malia. Mean errors for the previous 5-yr period are shown for comparison. Official errors that are smaller than the 5-yr means are shown in boldface type.

	Forecast Period (h)						
	12	24	36	48	72	96	120
OFCL	<b>3.5</b>	<b>5.9</b>	<b>6.7</b>	<b>3.6</b>	<b>7.5</b>	-	-
OCD5	7.9	8.3	8.7	1.6	33.0	-	-
Forecasts	13	11	9	7	2	0	0
(CP) OFCL (2010-14)	4.8	8.6	11.6	13.8	18.5	19.3	20.4

Table 4b. Homogeneous comparison of selected intensity forecast guidance models (in kt) for Malia. Errors smaller than the CPHC official forecast are shown in boldface type. The number of official forecasts shown here will generally be smaller than that shown in Table 4a due to the homogeneity requirement.

Model ID	Forecast Period (h)						
	12	24	36	48	72	96	120
OFCL	2.9	6.0	7.5	3.6	7.5	-	-
OCD5	7.3	7.8	8.4	<b>1.6</b>	33.0	-	-
HWFI	4.3	<b>4.3</b>	<b>3.6</b>	5.1	<b>4.5</b>	-	-
GHMI	7.6	10.7	20.6	23.6	32.0	-	-
AVNI	4.6	<b>4.4</b>	<b>5.4</b>	7.4	8.5	-	-
EMXI	4.1	<b>5.2</b>	<b>4.6</b>	<b>4.3</b>	<b>1.0</b>	-	-
IVCN	4.5	<b>5.9</b>	<b>6.5</b>	6.4	9.0	-	-
SHIP	5.3	7.9	8.9	7.9	<b>7.0</b>	-	-
DSHIP	5.3	7.9	8.9	7.9	<b>7.0</b>	-	-
LGEM	4.6	8.6	12.3	11.9	8.5	-	-
Forecasts	12	10	8	7	2	0	0

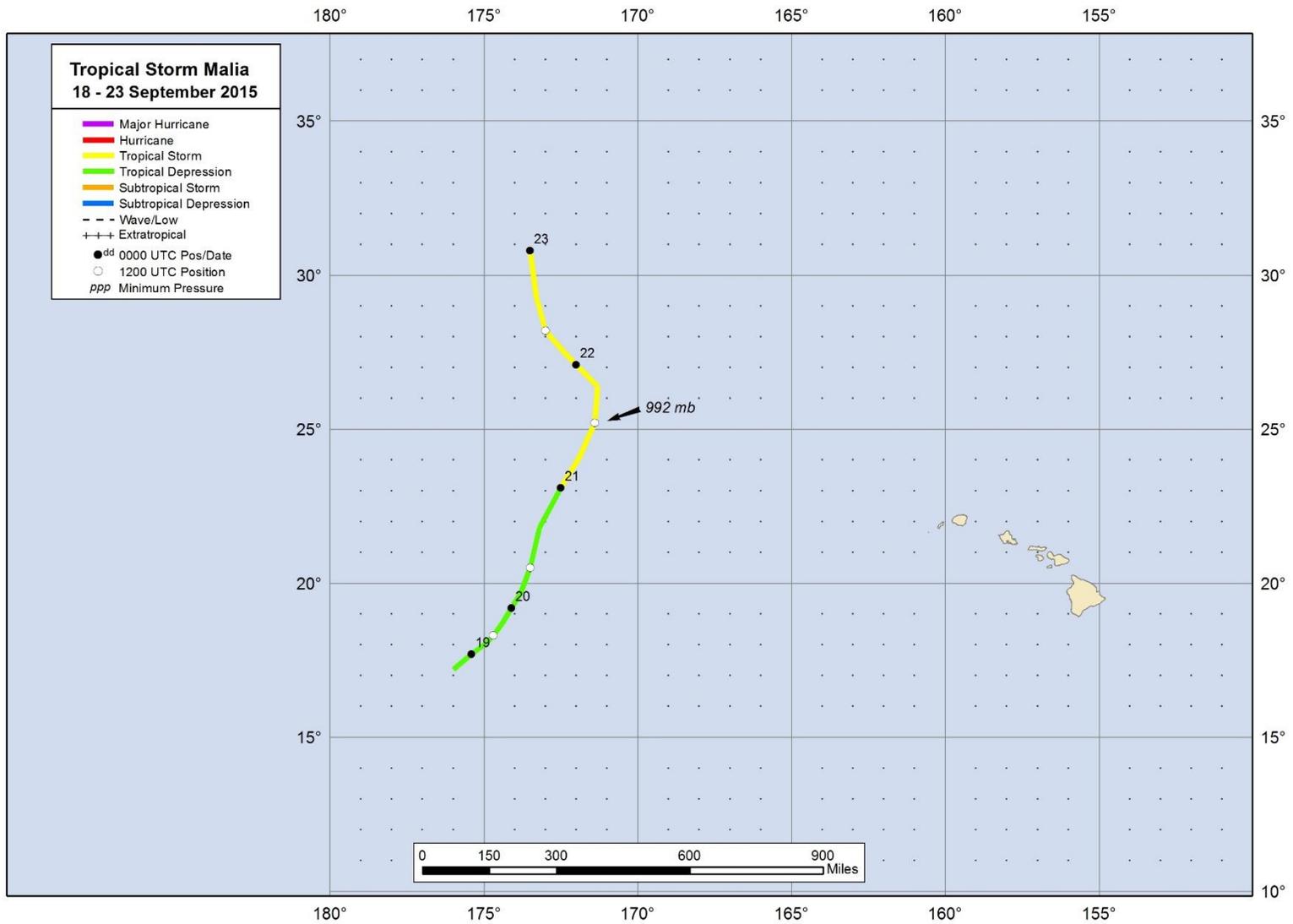


Figure 1. Best track positions for Tropical Storm Malia, 18-23 September 2015.